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IER

EUSUSTEL

European Sustainable Electricity; Comprehensive Analysis of Future European Demand and Generation of European Electricity and its Security of Supply

WP8.2: „Development of conceptual framework for sustainable electricity supply“

WP8.2: „Conceptual framework for sustainable development“

- Sustainable development is the general accepted guiding principle (concept) for further development.

Gothenburg European Council (2001)

- "Sustainable Development offers the European Union **a positive long-term vision** of a society that is more prosperous and more just, and which promises a cleaner, safer, healthier environment – a society which delivers a better quality of life for us, for our children, and for our grandchildren. Achieving this in practice requires that economic growth supports social progress and respects the environment, that social policy underpins economic performance, and that environmental policy is cost-effective."

- But, there are many different definitions and interpretations of ‘sustainable development’.A widely accepted operational definition of SD, is lacking.

WP8.2: „Conceptual framework for sustainable development“

- Various international and national organisations have been developing criteria and sets of indicators to measure and assess one or more aspects of Sustainable Development
- Indicators for Sustainable Development in General
  - CSD
  - OECD
  - EU Commission
- Indicators for Sustainable Development of the Energy Sector
  - IAEA, UNDESA, IEA, Eurostat and EEA
  - Enquete Commission of the German Parliament
  - International Committee of Nuclear Energy (ILIC)
- But, a generally acknowledged set of specific indicators does not currently exist and approaches for integrating them, to assess the sustainability performance, have not yet been established.

WP8.2: „Conceptual framework for sustainable development“

Objective of the EUSUSTEL project: „*To provide the Commission and the member states with coherent guidelines and recommendations to optimise the future nature of electricity provision and the electricity generation mix in Europe so as to guarantee affordable, clean and reliable, i.e ‚sustainable‘, electriciyty supply system*“

- This requires a common understanding of ‚Sustainable Development‘ amongst the project partners, which is also be used to assess the EUSUSTEL scenarios

WP8.2: „Conceptual framework for sustainable development“

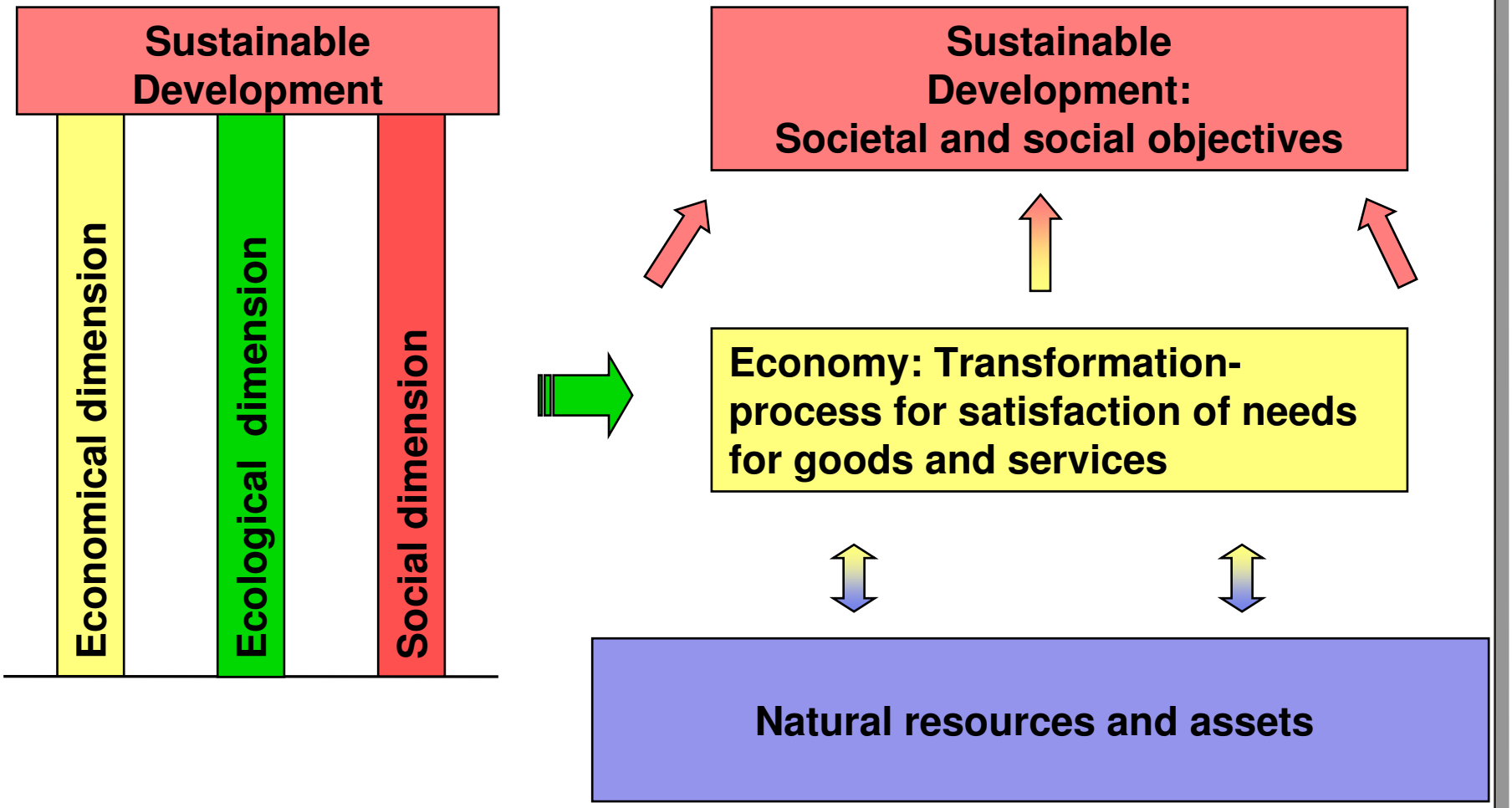
Sustainability Concepts

- Weak Sustainability:
  - Substitution paradigm – postulating a largely substitutability of natural resources by man-made capital

- Strong Sustainability:
  - Non-substitutability of natural capital by man-made capital; preservation of naturel capital

- Three – Pillar Model
  - Economical dimension
  - Ecological dimension
  - Social dimension

WP8.2: „Conceptual framework for sustainable development“



The Brundtland Commission ‘s Definition of Sustainable Development

"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

It’s “a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are made consistent with future as well as present needs.”

The challenge is to simultaneously help to deliver economic prosperity, to reduce and eliminate poverty, to provide environmental quality and social equity and to maintain the natural foundations of life in spite of a growing global population.

"Sustainable development": What does it mean for the energy sector

- Scientific fundamentals
- Sustainability and the use of finite *(non-renewable)* resources
- Sustainability and the economic principle

➢ Scientific fundamentals

- Second law of thermodynamics => Life and development of economical and cultural achievements require a permanent input of workable energy and material.

- Growing knowledge (*Gestaltungsfähigkeit*) and the connected possible technological progress create the base for preserving and expanding the abilities of future generations.

- Environmental pollution results from the release of substances into the environment, not from the energy degradation.

➢ Sustainability and the use of finite *(non-renewable)* resources

- Can the use of finite resources (e.g. Oil and Coal) be consistent with the principles of sustainability?

- Supply of energy service requires the use of workable energy, but also the use of non-energetic resources and materials.

- Use of finite resources require a compensation
  => the extension of the technical-economical accessible resource base for the provision of energy services.

- State of technology determines the technological-economical accessible base *(potential)* of raw materials and energy as well as the productivity of the resource base.

➢ Sustainability and the economic principle

- Prudent use of scarce resources (incl. the environmental resources) represents a key aspect of sustainability.

  => Energy services to be provided using the minimal amount of energy,material and other resources possible.

- Also the general economic principle targets at minimising the use of resources.

  => Costs and prices are a measure for use of various scarce resources.

Total resource use has to be taken into account

=> Internalisation of external costs (Getting prices right).

Sustainable energy provision if

- The potential for an economic provision of energy services increases (or does not decrease) for the following generations.
- The substance release due to energy service provision does not exeed the assimilation capacity of the natural environment.
- The energy related risk for human health are smaller than the avoided natural risk due to the provision of energy services.
- Energy services are provided with the least resource input possible, including the environmental resources.

Relative sustainability of energy technologies and energy supply chains

- Total resource consumption of energy technologies or energy supply chains is a measure with repect to their relative sustainability.

- Total social cost (i.e. private cost plus external cost) is a useful indicator to account for overall resource consumption per energy service unit.

=> Measure for the relative sustainability

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- Potential for beneficial supply of energy services for following generations should be enlarged, i.e. extension of economical useful energy and resource basis.
- Energy supply induced emission should not exeed absorption capacity of natural resources as a sink.
- Energy supply related risk for health should be smaller than the avoided natural risk due to the use of energy services.
- Energy services should be provided by a minimum of resources used, regarding sources and sinks.
- Relative Sustainability of energy systems can be measured by the amount of resouces used per energy service unit, i.e. overall private and social cost for energy provision.

Sustainable energy supply: management rules (1/2)

1. Use of renewable resources must not exceed their rate of regeneration.

2. Use of non-renewable energy carriers and raw materials requires a compensation for future generations. This compensation requires the extension of the technical-economical accessable resource base.

3. Emissions of substances into the environment shall not exceed the absorption capacity respectively the ability for assimilation of the natural environment.

4. Hazards and risks for human health and environment from energy provision should be smaller than the avoided natural risks due to the use of energy services.

Sustainable energy supply: rules for orientation and activities (2/2)

5. Energy services should be provided by a minimum of resources used, I.e. with the possibly lowest total costs (private plus external costs).

6. Relative Sustainability of energy systems can be measured by the amount of resources used per energy service unit, I.e. total (social) cost.

SD Indicators of IAEA, UNDESA, IEA, Eurostat and EEA

Social				
Theme	**Sub-theme**	**Energy Indicator**		**Components**
Equity	Accessibility	SOC1	Share of households (or population) without electricity or commercial energy, or heavily dependent on non-commercial energy	– Households (or population) without electricity or commercial energy, or heavily dependent on non-commercial energy – Total number of households or population
	Affordability	SOC2	Share of household income spent on fuel and electricity	– Household income spent on fuel and electricity – Household income (total and poorest 20% of population)
	Disparities	SOC3	Household energy use for each income group and corresponding fuel mix	– Energy use per household for each income group (quintiles) – Household income for each income group (quintiles) – Corresponding fuel mix for each income group (quintiles)
Health	Safety	SOC4	Accident fatalities per energy produced by fuel chain	– Annual fatalities by fuel chain – Annual energy produced

Economic				
Theme	**Sub-theme**	**Energy Indicator**		**Components**
Use and Production Patterns	Overall Use	ECO1	Energy use per capita	– Energy use (total primary energy supply, total final consumption and electricity use) – Total population
	Overall Productivity	ECO2	Energy use per unit of GDP	– Energy use (total primary energy supply, total final consumption and electricity use) – GDP
	Supply Efficiency	ECO3	Efficiency of energy conversion and distribution	– Losses in transformation systems including losses in electricity generation, transmission and distribution
	Production	ECO4	Reserves-to-production ratio	– Proven recoverable reserves – Total energy production
		ECO5	Resources-to-production ratio	– Total estimated resources – Total energy production

	End Use	ECO6	Industrial energy intensities	– Energy use in industrial sector and by manufacturing branch – Corresponding value added
		ECO7	Agricultural energy intensities	– Energy use in agricultural sector – Corresponding value added
		ECO8	Service/ commercial energy intensities	– Energy use in service/ commercial sector – Corresponding value added
		ECO9	Household energy intensities	– Energy use in households and by key end use – Number of households, floor area, persons per household, appliance ownership
		ECO10	Transport energy intensities	– Energy use in passenger travel and freight sectors and by mode – Passenger-km travel and tonne-km freight and by mode

Economic				
Theme	**Sub-theme**	**Energy Indicator**		**Components**
	Diversification (Fuel Mix)	ECO11	Fuel shares in energy and electricity	– Primary energy supply and final consumption, electricity generation and generating capacity by fuel type – Total primary energy supply, total final consumption, total electricity generation and total generating capacity
		ECO12	Non-carbon energy share in energy and electricity	– Primary supply, electricity generation and generating capacity by non-carbon energy – Total primary energy supply, total electricity generation and total generating capacity
		ECO13	Renewable energy share in energy and electricity	– Primary energy supply, final consumption and electricity generation and generating capacity by renewable energy – Total primary energy supply, total final consumption, total electricity generation and total generating capacity

	Prices	ECO14	End-use energy prices by fuel and by sector	– Energy prices (with and without tax/subsidy)
Security	Imports	ECO15	Net energy import dependency	– Energy imports – Total primary energy supply
	Strategic Fuel Stocks	ECO16	Stocks of critical fuels per corresponding fuel consumption	– Stocks of critical fuel (e.g. oil, gas, etc.) – Critical fuel consumption

Environmental				
Theme	**Sub-theme**	**Energy Indicator**		**Components**
Atmosphere	Climate Change	ENV1	GHG emissions from energy production and use per capita and per unit of GDP	– GHG emissions from energy production and use – Population and GDP
	Air Quality	ENV2	Ambient concentrations of air pollutants in urban areas	– Concentrations of pollutants in air
		ENV3	Air pollutant emissions from energy systems	– Air pollutant emissions
Water	Water Quality	ENV4	Contaminant discharges in liquid effluents from energy systems including oil discharges	– Contaminant discharges in liquid effluents

Land	Soil Quality	ENV5	Soil area where acidification exceeds critical load	– Affected soil area – Critical load
	Forest	ENV6	Rate of deforestation attributed to energy use	– Forest area at two different times – Biomass utilization
	Solid Waste Generation and Management	ENV7	Ratio of solid waste generation to units of energy produced	– Amount of solid waste – Energy produced
		ENV8	Ratio of solid waste properly disposed of to total generated solid waste	– Amount of solid waste properly disposed of – Total amount of solid waste
		ENV9	Ratio of solid radioactive waste to units of energy produced	– Amount of radioactive waste (cumulative for a selected period of time) – Energy produced

Environmental				
Theme	**Sub-theme**	**Energy Indicator**		**Components**
		ENV10	Ratio of solid radioactive waste awaiting disposal to total generated solid radioactive waste	– Amount of radioactive waste awaiting disposal – Total volume of radioactive waste


Thank you very much for your attention!